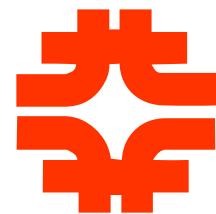
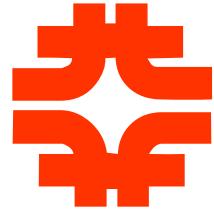


Run II b Briefing for the Directorate



Dave McGinnis
April 18, 2001



Charge

From: Steve Holmes [SMTP:holmes@fnal.gov]
Sent: Friday, March 23, 2001 11:00 AM
To: McGinnis, David; Marriner, John
Subject: Run IIB Briefing

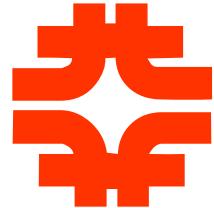
Dave & John,

Here is what we (2nd floor) think we would like to hear about at the briefing on April 18:

1. Identification/prioritization of subprojects that you feel need to be executed as part of the Run IIB plan.
2. State of affairs with regard to organizing the effort.
3. Estimated costs of the subprojects.
4. Estimated schedule on which the subprojects could be completed. This includes preliminary assessment of the need to schedule major shutdowns.

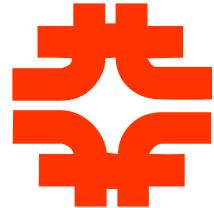
We are well aware that items 3. and 4. are going to be "tops-down" at this point. Let us know if you see a significant mismatch between our expectations for this meeting and yours.

Thanks,
Steve



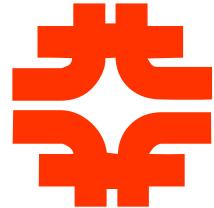
Identification/prioritization of subprojects

- 1. Slip Stacking
 - More protons on target
- 2. MI Beam loading
 - More protons on target
- 3. AP5 line
 - Better antiproton transfer efficiency
- 4. AP2 & Debuncher Aperture Upgrades
 - Better antiproton collection efficiency
- 5. Solid Lens R&D -
 - Better antiproton collection efficiency



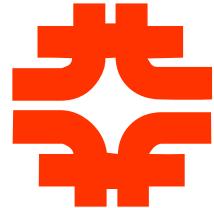
Identification/prioritization of subprojects

- 6. Accumulator Cooling
 - Better cooling
- 7. Recycler Electron Cooling
 - Better cooling
- 8. Debuncher Lattice Upgrades
 - Better antiproton collection efficiency
- 9. Linac Ion Source
 - More protons on target
- 10. TEV Tune shift compensation
 - More protons at collisions



Identification/prioritization of subprojects

- 11. Booster ramped correctors
 - More protons on target
- 12. Booster cogging
 - More protons on target
- 13. TEV. Long dampers
 - More protons at collisions
- 14. TEV Beam loading
 - More protons at collisions
- 15. Liquid Lens R&D
 - Better antiproton collection efficiency



WPAS 2002 Run 2b Project Description

● Main Injector Slip Stacking

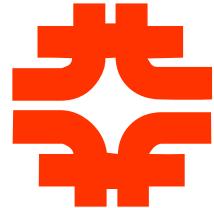
- This modification is in support of the Run IIb luminosity upgrades. This project will increase the Main Injector beam intensity for antiproton production by coalescing two Booster batches at 8 GeV.

● Main Injector Beam Loading Compensation

- This modification is in support of the Run IIb luminosity upgrades. Transient beam loading is expected to limit the amount of proton intensity at 8 GeV in the Main Injector. This project will install fast RF feedback in the Main Injector High Level RF that will eliminate the transient beam induced wakefields. The elimination of transient beam loading will permit higher Main Injector intensities for antiproton production

● AP-5 Line

- This project is in support of the Run IIB luminosity upgrades. This project will be a dedicated 8 GeV beam line to transfer antiprotons from the Accumulator to the Recycler



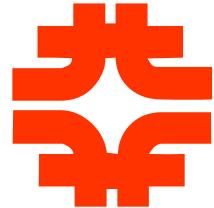
WPAS 2002 Run 2b Project Description

● AP2 and Debuncher Aperture Increase

- This modification is in support of the Run IIb luminosity upgrades. The AP2 acceptance and the Debuncher aperture will be increased to $40 \pi \text{ mm-mrad}$ to increase the antiproton flux in the Debuncher. This project will include mechanical aperture increases along with beam based alignment techniques. The beam based alignment will require upgrades to the present BPM system. This project should start in FY2002. However, there is not enough funding available in the current budget guidance to start this project until FY2004.

● Solid Lithium Lens Gradient Upgrade

- This modification is in support of the Run IIb luminosity upgrades. This project will research a number of design modifications of the current solid lithium lens that will increase the gradient of the lens.



WPAS 2002 Run 2b Project Description

● **Accumulator Stack Tail Cooling**

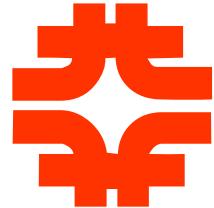
- This modification is in support of the Run IIb luminosity upgrades. An increase in the antiproton flux beyond the Run II level of 20×10^{10} antiprotons/hr requires further improvements in the stack tail cooling system. This project should start in FY2003. However, there is not enough funding available in the current budget guidance to start this project until FY2004.

● **Recycler Electron Cooling**

- This modification is in support of the Run IIb luminosity upgrades. Higher antiproton fluxes require better Recycler cooling. These requirements will be met with an electron cooling system.

● **Debuncher Lattice Upgrades**

- This modification is in support of the Run IIb luminosity upgrades. This project will research coupling, harmonic, and dispersion corrections and a gamma-t ramp to the Debuncher lattice so that the Debuncher's dynamic aperture is increased.



WPAS 2002 Run 2b Project Description

● Linac Ion Source

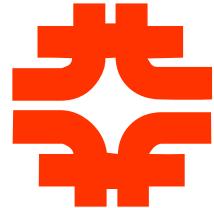
- This modification is in support of the Run IIb luminosity upgrades. The intensity of the H- ion source will be increased and the emittance of the H- beam will be decreased. The increase in beam brightness should permit the Booster to run with less beam loss.

● TEVATRON Beam Beam Tune Shift Compensation

- This modification is in support of the Run IIb luminosity upgrades. The variation in antiproton betatron tunes will be corrected with a modulated low energy electron beam.

● Booster Ramped Correctors

- This modification is in support of the Run IIb luminosity upgrades. The correction system in the Booster will be modified to ramp. This should permit the Booster to run with less beam loss.



WPAS 2002 Run 2b Project Description

● **Booster Cogging.**

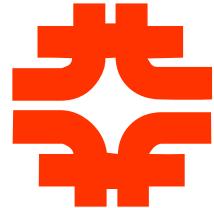
- This modification is in support of the Run IIb luminosity upgrades. This project will permit a gap to be placed in the Booster beam at 400 MeV and aligned with the Booster extraction septum at 8 GeV to minimize losses during extraction from the Booster.

● **Tevatron Longitudinal Dampers**

- This modification is in support of the Run IIb luminosity upgrades. For 132 nS bunch spacing, longitudinal instabilities are anticipated. There is not enough funding available in the current budget guidance to do this project.

● **Tevatron Beam Loading Compensation**

- This modification is in support of the Run IIb luminosity upgrades. For 132 nS bunch spacing, transient beam loading problems are anticipated. There is not enough funding available in the current budget guidance to do this project.



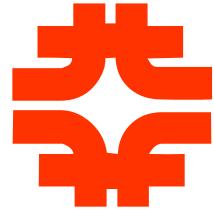
WPAS 2002 Run 2b Project Description

● Liquid Lithium Lens

- This modification is in support of the Run IIb luminosity upgrades. This project is based on an R&D program underway at BINP. There is not enough funding available in the current budget guidance to continue this project.

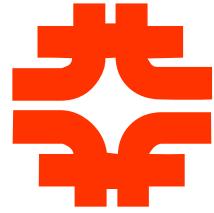
● Linac Front End Upgrade

- This modification is in support of the Run IIb luminosity upgrades. The Crockoft-Walton of the Proton Source will be replaced by two RFQs and the first drift tube of the Linac will be modified to reduce initial losses in the Linac. The increase in beam brightness should permit the Booster to run with less beam loss. There is not enough funding available in the current budget guidance to do this project.



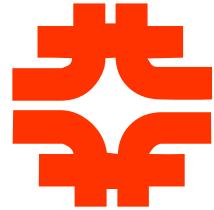
Run 2b Organization

- There is a weekly Run II B meeting with the 15 "project leaders"
 - More people can attend if they wish but those 15 should be there.
 - At each meeting there is a 20-30 min report from two of the projects.
 - We rotate through the 15 projects in 2 months.
 - Projects that have given reports to date:
 - * Slip Stacking
 - * Beam Loading
 - * Electron Cooling
 - * Solid Lens R&D
 - * Debuncher Lattice Upgrade
 - * AP2-Debuncher Aperture Upgrade



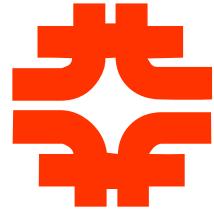
Run 2b Organization

- Each of the "project leaders" has been asked to try to assemble a team.
 - Some of the projects, the team size is one.
 - The project leaders are to organize some sort of regular meeting with their group.
 - The first task of each project is define the scope of their project.
- The Run 2b coordinator is to have a one hour meeting with each of the project leaders each week.
 - Not started because of Run 2a commissioning



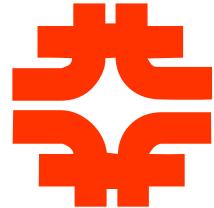
Run 2b Project Leaders

- 1. Slip Stacking - [Stemiel](#)
- 2. MI Beam loading - [Reid](#)
- 3. AP5 line - [Lebedev](#)
- 4. AP2 & Debuncher Aperture Upgrades - [Gollwitzer](#)
- 5. Solid Lens R&D - [Hurh](#)
- 6. Accumulator Cooling - [Derwent](#)
- 7. Recycler Electron Cooling - [Nagitsev](#)
- 8. Debuncher Lattice Upgrades - [Werkema](#)



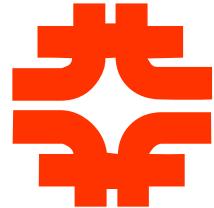
Run 2b Project Leaders

- 9. Linac Ion Source - [Dudnikov or Moehs](#)
- 10. TEV Tune shift compensation - [Shiltsev](#)
- 11. Booster ramped correctors - [Webber or designee](#)
- 12. Booster cogging - [Webber or designee](#)
- 13. TEV. Long dampers - [Tan](#)
- 14. TEV Beam loading - [Tan](#)
- 15. Liquid Lens R&D - [Leveling](#)



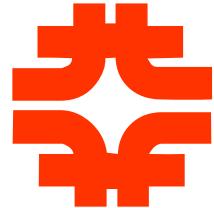
Run 2b Organizational Goals for CY2001

- Design Report Rough Draft for next Accelerator Advisory Committee (AAC) meeting (May 21-22, 2001)
 - Description of overall Run 2b plan will be written.
 - Rough draft will include only the scope of each Run 2b project.
- Design Report finished by October 1, 2001
 - Will include the scope, resource requirements, and schedule for each Run 2b project.
- Dedicated Run 2b project review by the AAC in December of 2001



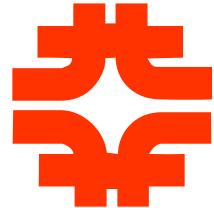
Present Technical Progress on Run 2b Projects

- Slip Stacking
 - Testing of DSP algorithms in low level RF has begun
 - Low intensity beam trials to start before May shutdown
 - Simulations of slip-stacking without beam loading replicated
 - Simulations of slip-stacking with beam loading underway.
- Beam loading
 - RF feedback at fundamental operational
 - Prototype RF feedback at $m=1$ lines to be tested summer 2001
 - IIR design awaiting results of simulations of slip-stacking with beam loading.



Present Technical Progress on Run 2b Projects

- AP5 line
 - Reverse proton tuneup for shot setup at about 1/2 hour
 - Redesign of 8 GeV AP3-AP1 lattice almost complete.
 - Power supply reconfiguration of 8 Gev AP3-AP1 and 120 GeV AP1 to take place during July 2001 shutdown
 - Transfer function measurements of 8 Gev P1-AP3 beam lines to begin May 2001.
- AP2 & Debuncher Aperture Upgrades
 - Optics redesign has been started
 - Transfer function measurements during May 2001 shutdown
 - BPM system design with CDF (Ohio State) has begun
 - Final installment of Debuncher Injection region improvements to be done during May 2001 shutdown



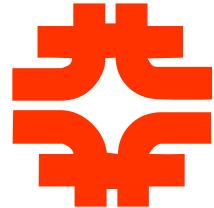
Present Technical Progress on Run 2b Projects

- Solid Lens R&D

- ANSYS mechanical and magnetic model of present lens nearly complete.
 - Initial MARS tracking results using ANSYS output as input have been completed (CDF- Bussey)
 - Fatigue tests of diffusion bonding underway.
 - 8 cm diffusion bonded mechanical design underway. Fabrication to begin in Fall 2001
 - No-beam Target Sweeping tests to begin Summer 2001

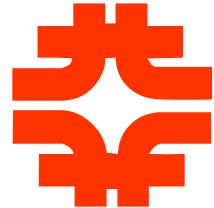
- Accumulator Cooling

- Not started



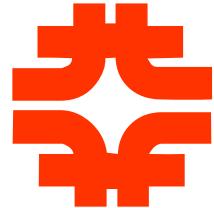
Present Technical Progress on Run 2b Projects

- Recycler Electron Cooling
 - High voltage testing of Pelletron well underway
 - Awaiting approval of SAD for electron beam re-circulation tests.
 - Construction of long beam-line mock-up well underway.
 - Preliminary civil construction design for MI-30 has been started.
- Debuncher Lattice Upgrades
 - Definition of beam studies just starting.
- Linac Ion Source
 - Not started



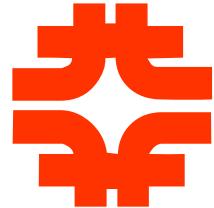
Present Technical Progress on Run 2b Projects

- TEV Tune shift compensation
 - Prototype system installed in TEVATRON
 - Tune shift of bunches observed
 - Future plans are awaiting outcome of TEV tests.
- Booster ramped correctors
 - Single sector linear electronics tested.
 - Power supply limitations require global software control.
- Booster cogging
 - First prototype successfully tested but caused large radial position excursions
 - Second prototype is built and lab tests are nearly complete. Beam tests will start before summer.



Present Technical Progress on Run 2b Projects

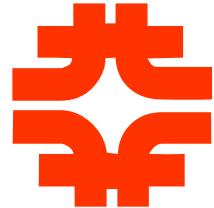
- TEV. Long dampers
 - Design of 36 x 36 digital under-sampled system has begun
- TEV Beam loading
 - Not started
- Liquid Lens R&D
 - Just finished second Fermilab review of BINP project.
 - 3rd lens prototype under construction with new titanium alloy.
 - Fermilab will receive liquid lithium magnetic pumping system this summer.
 - Fermilab will receive power supply this fall.



Estimated Cost of Run 2b Projects

(WPAS version)

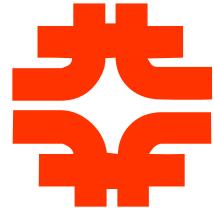
	FY01	FY02	FY03	FY04	FY05	Run IIb		Start Date	Operational Date
	Total	Total	Total	Total	Total	Total			
PS	249	367	389	231	0	1235		Mar - FY01	Mar - FY04
Linac	149	167	139	231	0	685		Mar - FY01	Jun - FY04
Ion Source R&D	149	167	139	231	0	685		Mar - FY01	Jun - FY04
Linac RFQ	0	0	0	0	0	0		-	-
Booster	100	200	250	0	0	550		Apr - FY01	Jul - FY03
Booster Cavities	0	0	0	0	0	0		-	-
Ramped Correctors	75	100	125	0	0	300		Feb - FY01	Jul - FY03
Longitudinal Dampers	0	0	0	0	0	0		-	-
Transverse Dampers	0	0	0	0	0	0		-	-
Cogging	25	100	125	0	0	250		Oct - FY02	Jul - FY03



Estimated Cost of Run 2b Projects

(WPAS version)

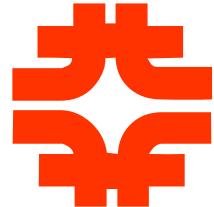
	FY01	FY02	FY03	FY04	FY05	Run IIb		Start Date	Operational Date
	Total	Total	Total	Total	Total	Total			
MI	77	693	0	0	0	770		Oct - FY02	Aug - FY02
RF	77	693	0	0	0	770		Oct - FY02	Aug - FY02
Slip Stacking	77	693	0	0	0	770		Oct - FY02	Aug - FY02
Low Level	34	306	0	0	0	340		Oct - FY02	Aug - FY02
Beam Loading Compensation	43	387	0	0	0	430		Sept - FY01	Aug - FY02
RF Power Upgrade	0	0	0	0	0	0		-	-
RR	2384	5637	5960	600	0	14580		May - FY01	Aug - FY03
Electron Cooling	2050	2700	4200	600	0	9550		Mar - FY01	Aug - FY03
AP5 line	334	2937	1760	0	0	5030		Oct - FY02	Jun - FY03
Design	110	115	125	0	0	350		Jan - FY01	Jun - FY03
Civil	211	1409	810	0	0	2430		Oct - FY02	Jun - FY03
Technical Components	13	1413	825	0	0	2250		Nov - FY02	Jun - FY03



Estimated Cost of Run 2b Projects

(WPAS version)

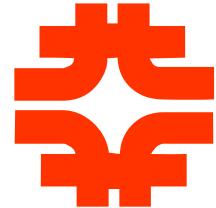
	FY01	FY02	FY03	FY04	FY05	Run IIb	Start Date	Operational Date
	Total	Total	Total	Total	Total	Total		
Pbar	329	673	1128	5824	5987	13940	Feb - FY03	Jul - FY05
Target Station	97	291	291	1291	1000	2970	Jun - FY02	Jun - FY05
Solid Lens R&D	97	291	291	1291	1000	2970	Jun - FY02	Jun - FY05
Liquid Lens R&D	0	0	0	0	0	0	-	-
Beam Sweeping	0	0	0	0	0	0	-	-
Debuncher	197	197	197	2368	2567	5525	Jul - FY03	Jul - FY05
Aperture	197	197	197	1543	1742	3875	Sept - FY02	Jul - FY05
BPM System	62	62	62	310	224	720	Nov - FY02	Jun - FY05
Moveable Quads	135	135	135	808	538	1750	Jan - FY02	Jun - FY05
Dipole Beam Pipe	0	0	0	425	980	1405	Jan - FY04	Aug - FY05
DRF1-1	0	0	0	0	0	0	-	-
Lattice Upgrades	0	0	0	825	825	1650	Dec - FY04	Jul - FY05
Coupling Correction	0	0	0	350	350	700	Dec - FY04	Jul - FY05
Resonance Correction	0	0	0	350	350	700	Dec - FY04	Jul - FY05
Gamma - t ramp	0	0	0	75	75	150	Dec - FY04	Jul - FY05
Dispersion Correction	0	0	0	50	50	100	Dec - FY04	Jul - FY05



Estimated Cost of Run 2b Projects

(WPAS version)

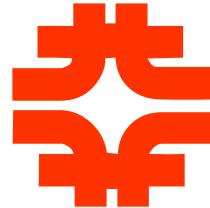
	FY01	FY02	FY03	FY04	FY05	Run IIb		Start	Operational
	Total	Total	Total	Total	Total	Total		Date	Date
Accumulator	0	0	0	1400	2270	3670		Jan - FY04	Aug - FY05
StackTail Betatron Cooling	0	0	0	450	740	1190		Jan - FY04	Aug - FY05
Core Tranverse Cooling	0	0	0	450	740	1190		Jan - FY04	Aug - FY05
StackTail Pickups	0	0	0	500	790	1290		Jan - FY04	Aug - FY05
Beam Lines	35	185	640	765	150	1775		Jul - FY02	Sept - FY04
Beam Position System	0	0	465	155	0	620		Nov - FY03	May - FY04
AP2 line	35	185	175	610	150	1155		Mar - FY02	Dec - FY05
Aperture	35	185	175	610	150	1155		Mar - FY02	Dec - FY05
Left Bends	0	10	0	610	150	770		Nov - FY04	Mar - FY05
Correctors	35	175	175	0	0	385		Oct - FY02	Jul - FY03
Chromatic Correction	0	0	0	0	0	0		-	-
AP1 Line	0	0	0	0	0	0		-	-
EPB dipole replacements	0	0	0	0	0	0		-	-
F17 Cmagnet Replacements	0	0	0	0	0	0		-	-



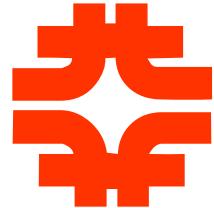
Estimated Cost of Run 2b Projects

(WPAS version)

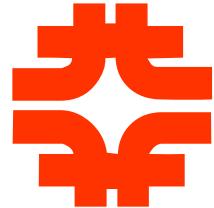
	FY01	FY02	FY03	FY04	FY05	Run IIb		Start Date	Operational Date
	Total	Total	Total	Total	Total	Total			
TEV	1000	1110	555	648	463	3775		Feb - FY01	Dec - FY05
Beam-Beam Tune Shift Compensation	1000	1110	555	648	463	3775		Feb - FY01	Dec - FY05
Beam Loading Compensation	0	0	0	0	0	0		-	-
Longitudinal Dampers	0	0	0	0	0	0		-	-



Labor Profile of Run 2b Projects (WPAS version)

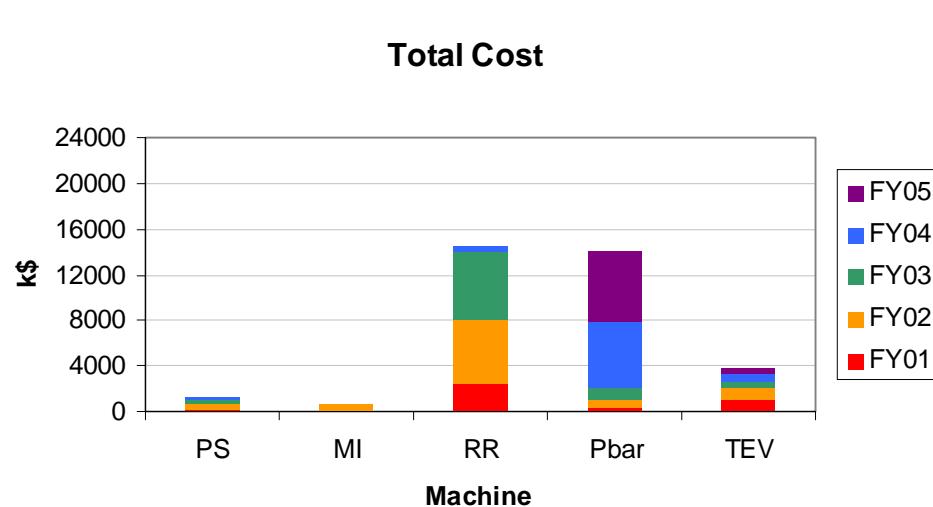
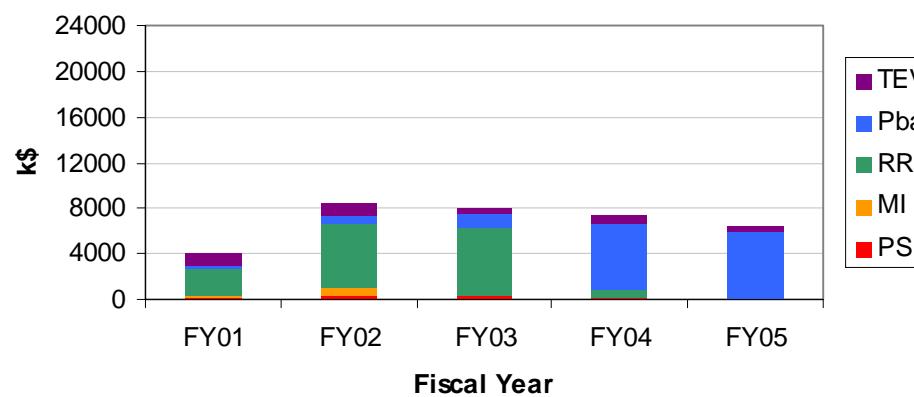


Labor Profile of Run 2b Projects (WPAS version)

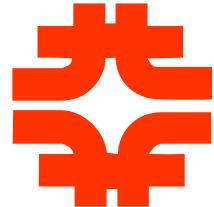


Total Cost for Run IIb

(WPAS version)



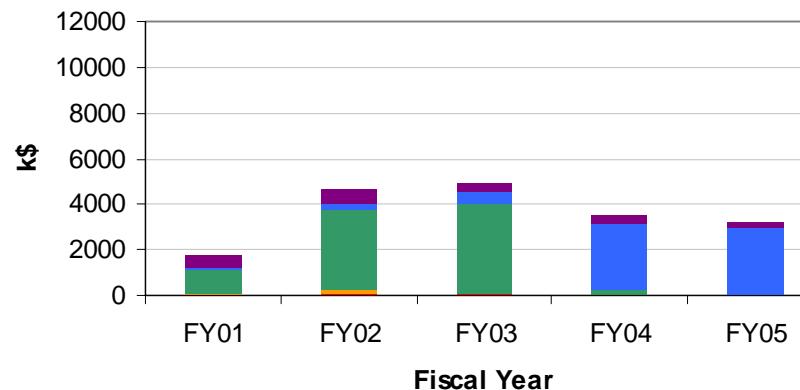
	FY01	FY02	FY03	FY04	FY05	Total
PS	249	367	389	231	0	1235
MI	77	693	0	0	0	770
RR	2384	5637	5960	600	0	14580
Pbar	329	673	1128	5824	5987	13940
TEV	1000	1110	555	648	463	3775
Total	4038	8479	8032	7302	6449	34300



M & S Cost for Run IIb

(WPAS version)

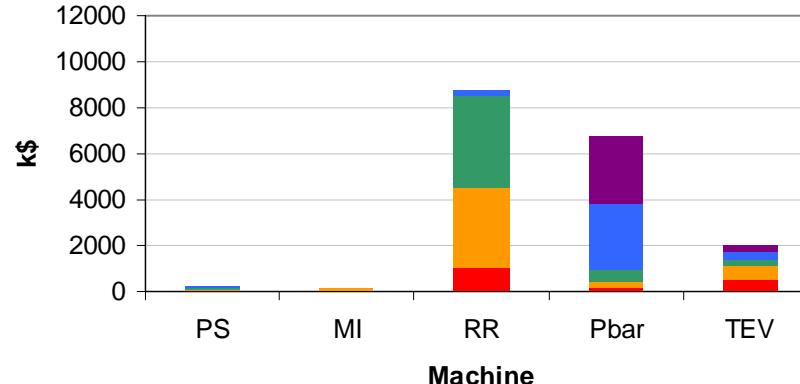
M & S



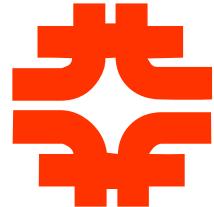
- TEV
- Pbar
- RR
- MI
- PS

	FY01	FY02	FY03	FY04	FY05	Total
PS	43	67	73	38	0	220
MI	20	180	0	0	0	200
RR	1050	3500	4000	250	0	8800
Pbar	145	285	510	2890	2985	6815
TEV	500	600	300	350	250	2000
Total	1758	4632	4883	3528	3235	18035

M & S



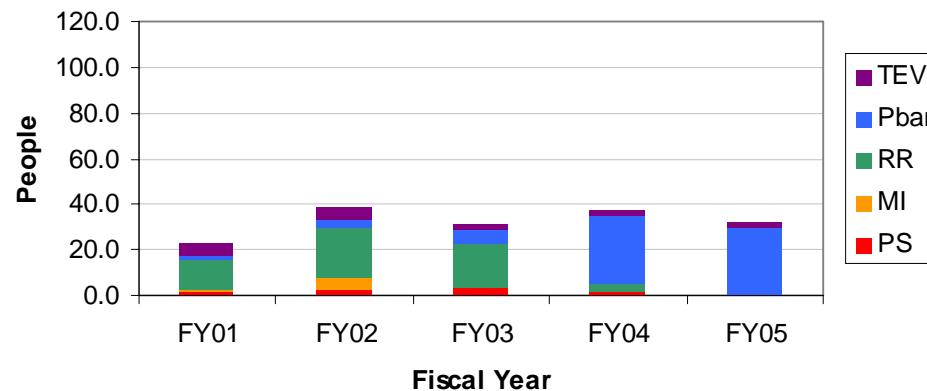
- FY05
- FY04
- FY03
- FY02
- FY01



Labor Cost for Run IIb

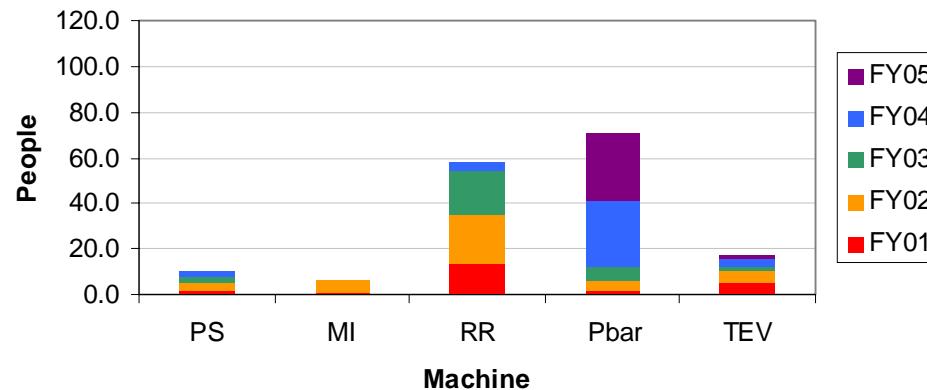
(WPAS version)

Total Labor

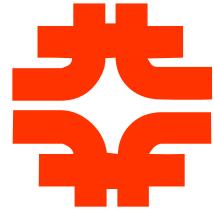


	Labor					
	FY01	FY02	FY03	FY04	FY05	Total
PS	2.1	3.0	3.2	1.9	0.0	10.2
MI	0.6	5.1	0.0	0.0	0.0	5.7
RR	13.3	21.4	19.6	3.5	0.0	57.8
Pbar	1.8	3.9	6.2	29.3	30.0	71.3
TEV	5.0	5.1	2.6	3.0	2.1	17.8
Total	22.8	38.5	31.5	37.7	32.1	162.7

Total Labor



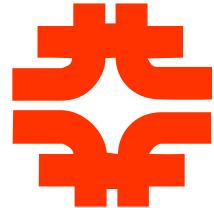
	Labor\$					
	FY01	FY02	FY03	FY04	FY05	Total
PS	206	300	316	194	0	1015
MI	57	513	0	0	0	570
RR	1334	2137	1960	350	0	5780
Pbar	184	388	618	2934	3002	7125
TEV	500	510	255	298	213	1775
Total	2280	3847	3149	3775	3214	16265



Project Schedule

(WPAS version)

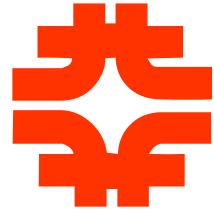
	Y 1	Y 2	Y 3	Y 4	Y 5	
	OND J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S					
PS						
Linac						
Ion Source R&D						
Linac RFQ						
Booster						
Booster Cavities						
Ramped Correctors						
Longitudinal Dampers						
Transverse Dampers						
Cogging						
MI						
RF						
Slip Stacking						
Low Level						
Beam Loading Compensation						
RF Power Upgrade						



Project Schedule (WPAS version)

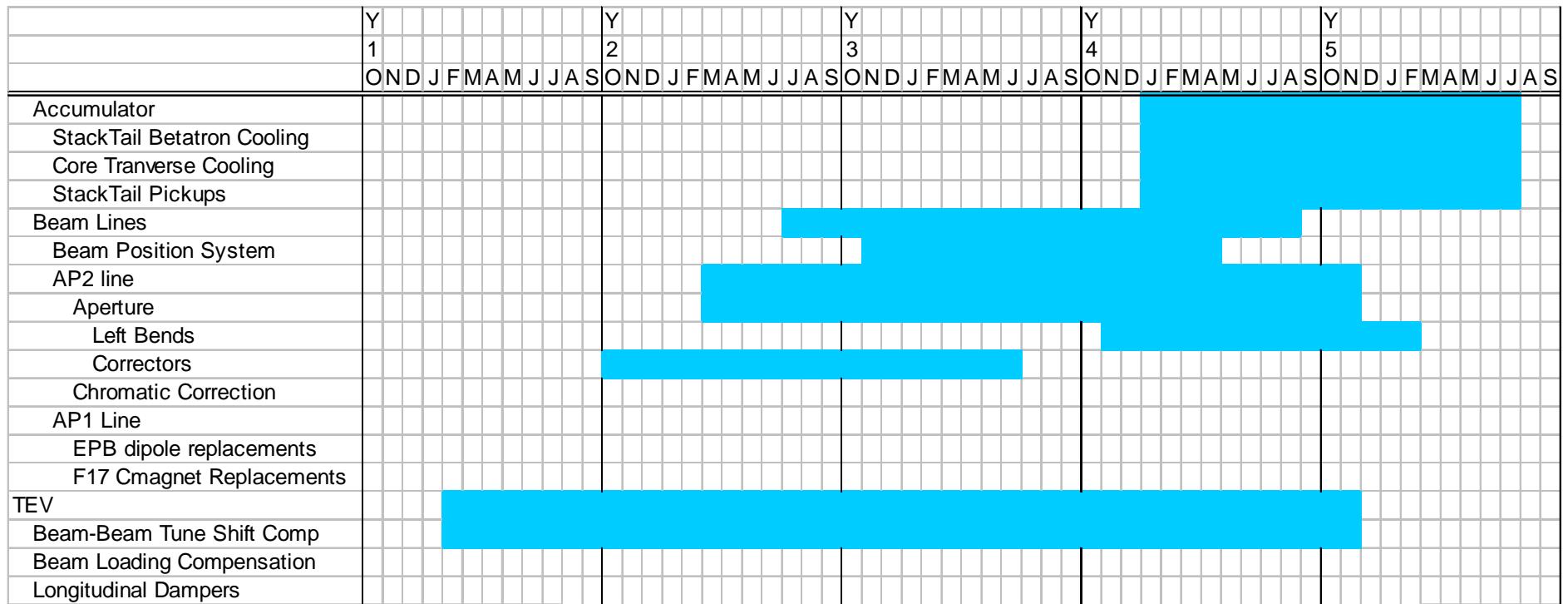
The Gantt chart illustrates the timeline for the construction of various LHCb detector components. The horizontal axis represents time, divided into five-year periods (Y1 to Y5). The vertical axis lists the components. Most components show a single blue bar indicating their duration, starting in Y1 or Y2 and ending in Y5. Some components, such as 'DRF1-1' and 'Lattice Upgrades', have very long bars extending into Y6.

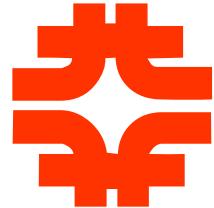
Component	Start Year	End Year
RR	Y1	Y5
Electron Cooling	Y1	Y5
AP5 line	Y1	Y5
Design	Y1	Y5
Civil	Y1	Y5
Technical Components	Y1	Y5
Pbar	Y1	Y5
Target Station	Y1	Y5
Solid Lens R&D	Y1	Y5
Liquid Lens R&D	Y1	Y5
Beam Sweeping	Y1	Y5
Debuncher	Y1	Y5
Aperture	Y1	Y5
BPM System	Y1	Y5
Moveable Quads	Y1	Y5
Dipole Beam Pipe	Y1	Y5
DRF1-1	Y1	Y6
Lattice Upgrades	Y1	Y6
Coupling Correction	Y1	Y6
Resonance Correction	Y1	Y6
Gamma - t ramp	Y1	Y6
Dispersion Correction	Y1	Y6



Project Schedule

(WPAS version)

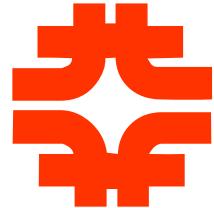




Estimated Cost of Run 2b Projects

(Opt. version)

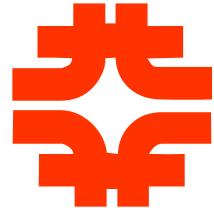
	FY01	FY02	FY03	FY04	FY05	Run IIb		Start Date	Operational Date
	Total	Total	Total	Total	Total	Total			
PS	249	367	389	231	0	1235		Mar - FY01	Mar - FY04
Linac	149	167	139	231	0	685		Mar - FY01	Jun - FY04
Ion Source R&D	149	167	139	231	0	685		Mar - FY01	Jun - FY04
Linac RFQ	0	0	0	0	0	0		-	-
Booster	100	200	250	0	0	550		Apr - FY01	Jul - FY03
Booster Cavities	0	0	0	0	0	0		-	-
Ramped Correctors	75	100	125	0	0	300		Feb - FY01	Jul - FY03
Longitudinal Dampers	0	0	0	0	0	0		-	-
Transverse Dampers	0	0	0	0	0	0		-	-
Cogging	25	100	125	0	0	250		Oct - FY02	Jul - FY03



Estimated Cost of Run 2b Projects

(Opt. version)

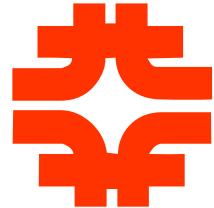
	FY01	FY02	FY03	FY04	FY05	Run IIb	Start Date	Operational Date
	Total	Total	Total	Total	Total	Total		
MI	77	693	0	0	0	770	Oct - FY02	Aug - FY02
RF	77	693	0	0	0	770	Oct - FY02	Aug - FY02
Slip Stacking	77	693	0	0	0	770	Oct - FY02	Aug - FY02
Low Level	34	306	0	0	0	340	Oct - FY02	Aug - FY02
Beam Loading Compensation	43	387	0	0	0	430	Sept - FY01	Aug - FY02
RF Power Upgrade	0	0	0	0	0	0	-	-
RR	2384	5637	5960	600	0	14580	May - FY01	Aug - FY03
Electron Cooling	2050	2700	4200	600	0	9550	Mar - FY01	Aug - FY03
AP5 line	334	2937	1760	0	0	5030	Oct - FY02	Jun - FY03
Design	110	115	125	0	0	350	Jan - FY01	Jun - FY03
Civil	211	1409	810	0	0	2430	Oct - FY02	Jun - FY03
Technical Components	13	1413	825	0	0	2250	Nov - FY02	Jun - FY03



Estimated Cost of Run 2b Projects

(Opt. version)

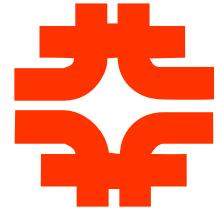
	FY01	FY02	FY03	FY04	FY05	Run IIb	Start Date	Operational
	Total	Total	Total	Total	Total	Total		Date
Pbar	489	3689	3027	4080	3095	14380	Jan - FY02	Apr - FY05
Target Station	97	291	291	1291	1000	2970	Jun - FY02	Jun - FY05
Solid Lens R&D	97	291	291	1291	1000	2970	Jun - FY02	Jun - FY05
Liquid Lens R&D	0	0	0	0	0	0	-	-
Beam Sweeping	0	0	0	0	0	0	-	-
Debuncher	357	3213	1796	599	0	5965	Oct - FY02	Oct - FY04
Aperture	192	1728	1796	599	0	4315	Nov - FY02	Jan - FY04
BPM System	62	558	75	25	0	720	Oct - FY02	Feb - FY03
Moveable Quads	68	608	806	269	0	1750	Dec - FY02	Feb - FY04
Dipole Beam Pipe	43	383	735	245	0	1405	Jan - FY02	Mar - FY04
DRF1-1	20	180	180	60	0	440	Nov - FY02	Jan - FY04
Lattice Upgrades	165	1485	0	0	0	1650	Oct - FY02	Aug - FY02
Coupling Correction	70	630	0	0	0	700	Oct - FY02	Aug - FY02
Resonance Correction	70	630	0	0	0	700	Oct - FY02	Aug - FY02
Gamma - t ramp	15	135	0	0	0	150	Oct - FY02	Aug - FY02
Dispersion Correction	10	90	0	0	0	100	Oct - FY02	Aug - FY02



Estimated Cost of Run 2b Projects

(Opt. version)

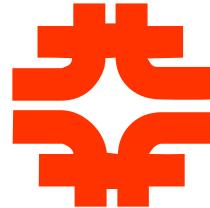
	FY01	FY02	FY03	FY04	FY05	Run IIb		Start Date	Operational Date
	Total	Total	Total	Total	Total	Total			
Accumulator	0	0	300	1425	1945	3670		Oct - FY04	Jul - FY05
Stack Tail Betatron Cooling	0	0	100	450	640	1190		Oct - FY04	Jul - FY05
Core Transverse Cooling	0	0	100	450	640	1190		Oct - FY04	Jul - FY05
Stack Tail Pickups	0	0	100	525	665	1290		Oct - FY04	Jul - FY05
Beam Lines	35	185	640	765	150	1775		Jul - FY02	Sept - FY04
Beam Position System	0	0	465	155	0	620		Nov - FY03	May - FY04
AP2 line	35	185	175	610	150	1155		Mar - FY02	Dec - FY05
Aperture	35	185	175	610	150	1155		Mar - FY02	Dec - FY05
Left Bends	0	10	0	610	150	770		Nov - FY04	Mar - FY05
Correctors	35	175	175	0	0	385		Oct - FY02	Jul - FY03
Chromatic Correction	0	0	0	0	0	0		-	-
AP1 Line	0	0	0	0	0	0		-	-
EPB dipole replacements	0	0	0	0	0	0		-	-
F17 Cmagnet Replacements	0	0	0	0	0	0		-	-



Estimated Cost of Run 2b Projects

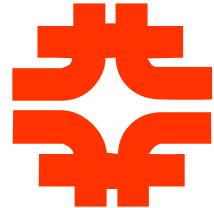
(Opt. version)

	FY01	FY02	FY03	FY04	FY05	Run IIb		Start Date	Operational Date
	Total	Total	Total	Total	Total	Total			
TEV	1020	1290	818	547	93	3766.5		Feb - FY01	Mar - FY04
Beam-Beam Tune Shift Compensation	1000	1110	555	259	93	3016.5		Jan - FY01	Dec - FY04
Beam Loading Compensation	0	0	113	238	0	350		Jan - FY03	Aug - FY04
Longitudinal Dampers	20	180	150	50	0	400		Nov - FY02	Dec - FY04



Labor Profile of Run 2b Projects

(Opt. version)



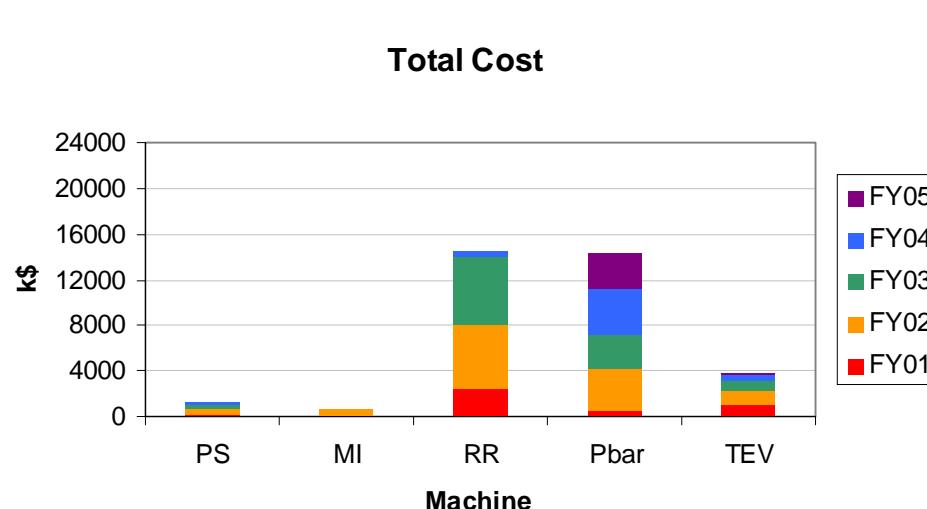
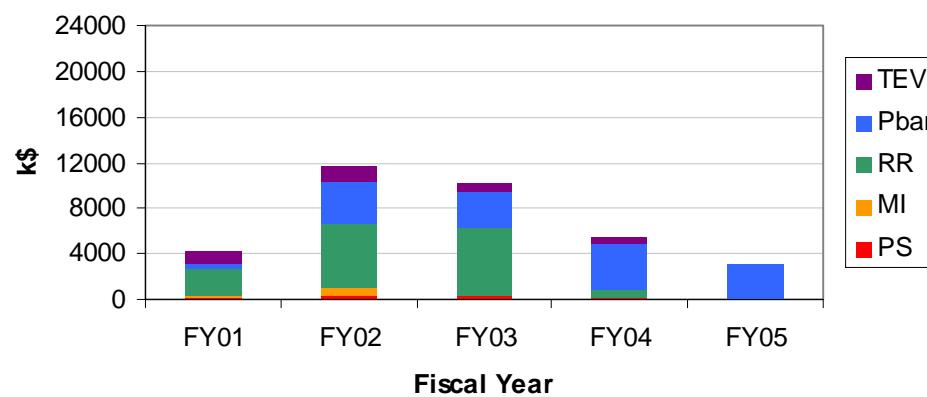
Labor Profile of Run 2b Projects

(Opt. version)

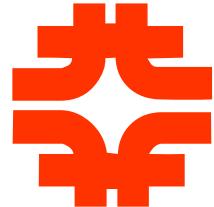


Total Cost for Run IIb

(Opt. version)



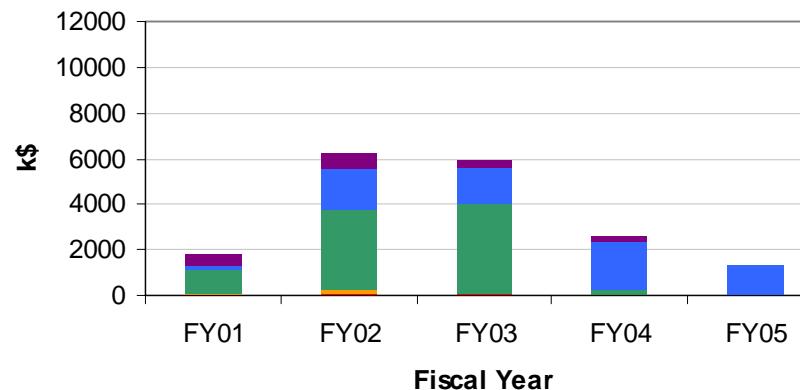
	FY01	FY02	FY03	FY04	FY05	Total
PS	249	367	389	231	0	1235
MI	77	693	0	0	0	770
RR	2384	5637	5960	600	0	14580
Pbar	489	3689	3027	4080	3095	14380
TEV	1020	1290	818	547	93	3766.5
Total	4218	11675	10194	5458	3188	34731.5



M & S Cost for Run IIb

(Opt. version)

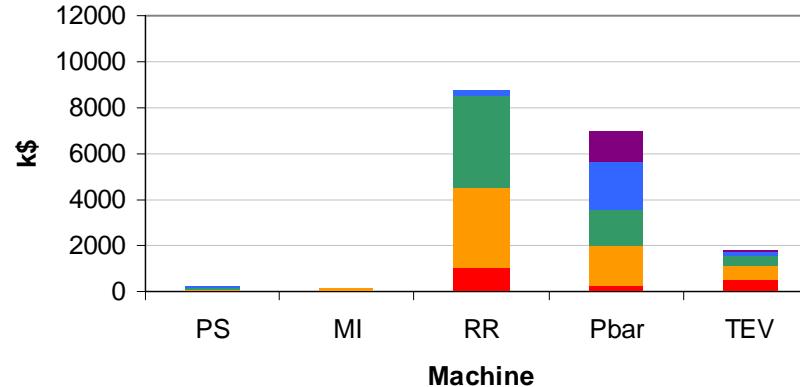
M & S



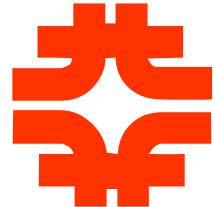
- TEV
- Pbar
- RR
- MI
- PS

	M&S					
	FY01	FY02	FY03	FY04	FY05	Total
PS	43	67	73	38	0	220
MI	20	180	0	0	0	200
RR	1050	3500	4000	250	0	8800
Pbar	232	1788	1553	2088	1275	6935
TEV	505	645	375	215	50	1790
Total	1850	6180	6000	2590	1325	17945

M & S



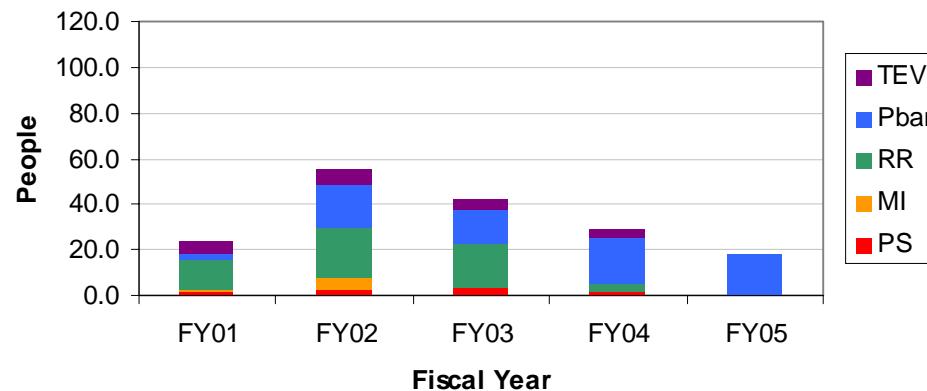
- FY05
- FY04
- FY03
- FY02
- FY01



Labor Cost for Run IIb

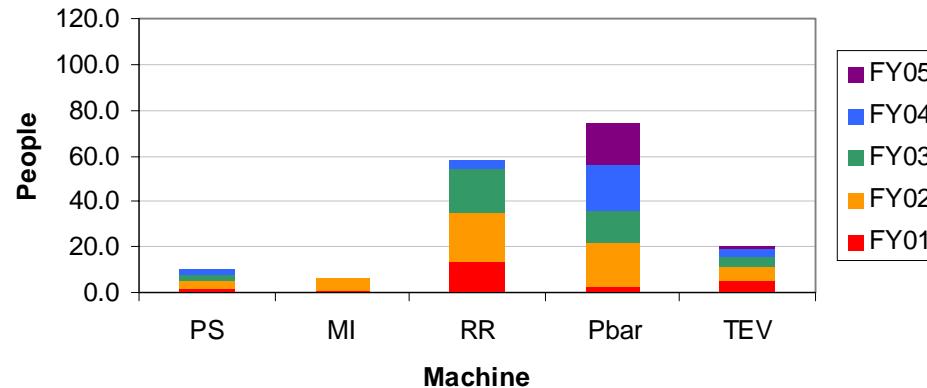
(Opt. version)

Total Labor

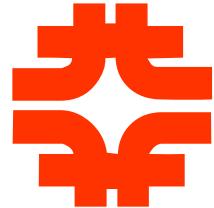


	Labor					
	FY01	FY02	FY03	FY04	FY05	Total
PS	2.1	3.0	3.2	1.9	0.0	10.2
MI	0.6	5.1	0.0	0.0	0.0	5.7
RR	13.3	21.4	19.6	3.5	0.0	57.8
Pbar	2.6	19.0	14.7	19.9	18.2	74.5
TEV	5.2	6.5	4.4	3.3	0.4	19.8
Total	23.7	55.0	41.9	28.7	18.6	167.9

Total Labor



	Labor\$					
	FY01	FY02	FY03	FY04	FY05	Total
PS	206	300	316	194	0	1015
MI	57	513	0	0	0	570
RR	1334	2137	1960	350	0	5780
Pbar	257	1901	1475	1992	1820	7445
TEV	515	645	443	332	43	1976.5
Total	2368	5495	4194	2868	1863	16786.5

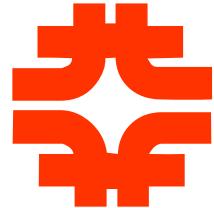


Project Schedule

(Opt. version)

The Gantt chart illustrates the project timelines for the Proton Synchrotron (PS) and Main Injector (MI) from January 2018 to December 2020. The x-axis is divided into 24 months (OND, J, F, M, A, M, J, J, A, S, OND, J, F, M, A, M, J, J, A, S, OND, J, F, M, A, M, J, J, A, S). The y-axis lists various projects under PS and MI categories.

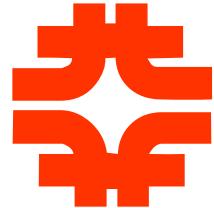
	Y1	Y2	Y3	Y4	Y5
PS					
Linac					
Ion Source R&D					
Linac RFQ					
Booster					
Booster Cavities					
Ramped Correctors					
Longitudinal Dampers					
Transverse Dampers					
Cogging					
MI					
RF					
Slip Stacking					
Low Level					
Beam Loading Compensation					
RF Power Upgrade					



Project Schedule

(Opt. version)

	Y1	Y2	Y3	Y4	Y5	
	OND	JFMAMJJA	OND	JFMAMJJA	OND	JFMAMJJA
RR						
Electron Cooling						
AP5 line						
Design						
Civil						
Technical Components						
Pbar						
Target Station						
Solid Lens R&D						
Liquid Lens R&D						
Beam Sweeping						
Debuncher						
Aperture						
BPM System						
Moveable Quads						
Dipole Beam Pipe						
DRF1-1						
Lattice Upgrades						
Coupling Correction						
Resonance Correction						
Gamma - t ramp						
Dispersion Correction						



Project Schedule

(Opt. version)